Final Report on the Breeding Bird Inventory at Colorado National Monument, Western Colorado

Glenn Giroir
Rocky Mountain Bird Observatory
14500 Lark Bunting Lane
Brighton, CO 81601
West Office
337 25 3/4 Road
Grand Junction, CO 81503

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Abstract

In order to collect baseline breeding bird information, during Spring 2000 I conducted a breeding bird inventory using distance sampling (Buckland et al. 1993) at Colorado National Monument in western Colorado. I conducted a series of point transects similar to those conducted in the *Monitoring Colorado's Birds* program (Leukering et al. unpubl.) that seeks to monitor the breeding birds of Colorado. I obtained data on 60 breeding bird species. White-throated Swift had the largest sample size with 304 individuals detected. Other species with large sample sizes included Pinyon Jay (n = 213), Bewick's Wren (n = 212), House Finch (n = 197), Black-throated Gray Warbler (n = 138), and Mourning Dove (n = 122). Only 16 individual raptors of six species were detected. Passerine species detected in low numbers (n < 5) included Dusky Flycatcher, Warbling Vireo, Mountain Chickadee, House Wren, Western Bluebird, Vesper Sparrow, Lark Sparrow, Bullock's Oriole, and Pine Siskin.

Introduction

Previous studies of the avifauna of Colorado National Monument have focused primarily on the breeding productivity of a selected few species (e.g., Peregrine Falcon and Gray Vireo). The density and abundance of most bird species breeding in Colorado National Monument (hereafter; Monument) has not been adequately determined. Lack of baseline breeding bird information limits the Monument's ability to develop adequate management guidelines for avian species and their habitats or to adequately protect species of concern. As part of a cooperative agreement between the Rocky Mountain Bird Observatory (RMBO) and the National Park Service (NPS), in 2000 I conducted a breeding-bird inventory in the Monument. The inventory was based on distance-sampling methods (Buckland et al. 1993). Distance sampling includes both line and point transects, and has been used for more than 30 years to estimate the population densities of animals, and in most situations, is considered the best method for determining relative population densities or trends for most bird species (Buckland et al. 1993, Fancey and Sauer 2000). For a detailed history and description of distance sampling and its use in the National Parks, see Fancey and Sauer 2000.

The point transect is the preferred sampling method in rugged or hazardous terrain where observers need to watch their footing as they walk transects (Fancey and Sauer 2000), which is the case in the Monument. I conducted a series of point transects similar to those that RMBO

conducts as part of the *Monitoring Colorado's Birds* program (Leukering et al. unpubl.). An advantage of such an inventory system is that if funding can be arranged to conduct the transects in future years, the inventory can evolve into a monitoring program. I obtained data on 60 species and determined densities of 25 of those (Table 1). This information will permit more effective management of the various habitats and bird species utilizing the Monument.

Methods

I established 27 10-point transects throughout the 78 km^2 of the Monument (Appendix 2). I selected starting points for the transects from a topographic map of the Monument overlaid with a grid of 180 points, with 1 km between grid points. Of the 180 points, I randomly chose 27. In a few instances, selected points fell on steep, inaccessible cliffs or slopes, so I randomly selected replacements from the original set of points.

One observer conducted each transect using the protocol established by Leukering et al. (unpubl). The observer located the selected point and ran the transect along a randomly selected bearing. For many transects, observers found it impossible to run the entire transect along the random bearing, as park boundaries and physical obstructions forced turns in the transect direction. When this occurred, the observer randomly turned right or left perpendicular to the original bearing, subsequently alternating perpendicular directions if additional turns were necessary. For many transects, topography (canyons and cliffs) dictated the bearings on which the transects ran.

Transects consisted of 10 five-minute point counts spaced at 250 m intervals along a line (Appendix 2). At the individual points, observers recorded all birds seen or heard, and the radial distance to each bird detected. Observers also recorded weather data (index of sky condition, which is a combination of cloud cover and precipitation; wind on the Beaufort scale; and temperature) and the time at the start and end of each transect. At each point, the observer recorded the UTM (Appendix 2) and whether or not the point was within 100 m of a road or trail. Upon arriving at a point, the observer recorded the weather and location data, then conducted the point count.

I used the program DISTANCE (Thomas et al. 1998) to analyze distance-estimate data. All references to density estimates are values provided by DISTANCE from the data. The notation, concepts, and analysis methods of the program were developed in Buckland et al. (1993).

Results

I obtained data on 60 breeding-bird species and provide a summary of these data in Table 1. For 25 of the species sampled, I obtained sufficient sample size ($n > 24$) to calculate densities (Table 1). White-throated swift had the largest sample size with 304 individuals detected (Table 1). Other species with large sample sizes included Pinyon Jay ($n = 213$), Bewick's Wren ($n = 212$), House Finch ($n = 197$), Black-throated Gray Warbler ($n = 138$), and Mourning Dove ($n = 122$) (Table 1). Bewick's Wren was found on the most transects and points, with the species detected on 26 of 27 transects and 150 of 270 points (Table 1). Observers detected only 16 individual raptors of six species (Table 1). Passerine species detected in low numbers ($n < 5$) included

Dusky Flycatcher, Warbling Vireo, Mountain Chickadee, House Wren, Western Bluebird, Vesper Sparrow, Lark Sparrow, Bullock's Oriole, and Pine Siskin (Table 1). Appendix 1 provides a detailed account of species distribution and abundance on each of the 27 point transects.

Table 1. Numbers of individual birds detected on 27 point transects and the estimated densities of bird species at Colorado National Monument. n = number of individuals detected; k = number of transects the species was detected on; D = estimated density / hectare, CI = 95% confidence interval; and, CV(%) = percent coefficient of variation.

Species	n	k	D	CI	CV(%)
Turkey Vulture	11	6			
Sharp-shinned Hawk	1	1			
Golden Eagle	5	5			
American Kestrel	3	2			
Prairie Falcon	1	1			
Peregrine Falcon	5	4			
Gambel's Quail	4	2			
Rock Dove	74	6	0.017	0.008 - 0.033	36.8
Mourning Dove	122	25	0.093	0.071 - 0.121	13.8
Northern Pygmy-Owl	1	1			
White-throated Swift	304	21	0.214	0.154 - 0.297	16.9
Black-chinned Hummingbird	16	10			
Broad-tailed Hummingbird	36	17	0.710	0.457 - 1.100	22.6
Northern "Red-shafted" Flicker	15	9			
Dusky Flycatcher	2	2			
Gray Flycatcher	112	22	0.230	0.187 - 0.292	11.3
Say's Phoebe	16	10			
Ash-throated Flycatcher	93	24	0.155	0.144 - 0.210	15.5
Gray Vireo	82	19	0.055	0.038 - 0.082	19.5
Plumbeous Vireo	27	13	0.030	0.018 - 0.049	25.0
Warbling Vireo	3	2			
Western Scrub-Jay	32	19	0.041	0.025 - 0.065	24.2
Pinyon Jay	213	14	0.150	0.078 - 0.283	34.0
Clark's Nutcracker	2	1			
Black-billed Magpie	2	1			
Common Raven	36	18	0.006	0.004 - 0.010	24.3
Violet-green Swallow	93	16	0.200	0.129 - 0.320	23.4
Cliff Swallow	1	1			
Black-capped Chickadee	4	2			
Mountain Chickadee	2	1			
Juniper Titmouse	61	20	0.230	0.160 - 0.334	19.0
Bushtit	53	18	0.964	0.603 - 1.540	
White-breasted Nuthatch	7	5			
Rock Wren	102	17	0.103	0.077 - 0.140	15.3

Table 1 continued.

Species	n	k	D	CI	CV(%)
Canyon Wren	45	10	0.034	0.023 - 0.050	20.0
Bewick's Wren	212	26	0.190	0.152 - 0.230	11.0
House Wren	3	1			
Blue-gray Gnatcatcher	99	23	0.840	0.613 - 1.140	16.0
Western Bluebird	1	1			
Mountain Bluebird	13	7			
Hermit Thrush	2	2			
Virginia's Warbler	62	14	0.071	0.048 - 0.106	21.0
Black-throated Gray Warbler	138	25	0.220	0.183 - 0.265	9.34
Western Tanager	2	1			
Green-tailed Towhee	2	2			
Spotted Towhee	113	21	0.180	0.133 - 0.243	15.2
Chipping Sparrow	97	23	0.254	0.191 - 0.334	15.0
Brewer's Sparrow	31	6	0.067	0.031 - 0.139	39.0
Vesper Sparrow	3	2			
Lark Sparrow	1	1			
Black-throated Sparrow	13	4			
Dark-eyed Junco	1	1			
Black-headed Grosbeak	3	1			
Lazuli Bunting	2	1			
Western Meadowlark	13	6			
Brown-headed Cowbird	35	16	0.063	0.032 - 0.126	35.0
Bullock's Oriole	3	3			
House Finch	197	24	0.470	0.367 - 0.592	12.2
Pine Siskin	1	1			
Lesser Goldfinch	3	2			

Discussion

As with any survey method, distance sampling and point transects have inherent difficulties that merit discussion. Although this survey included all birds that breed in the Monument, in most bird surveys the majority of birds are heard but not seen. Silent members of the bird community (e.g., birds of prey and vultures) are difficult to detect and were likely under-recorded. For example, while observers detected only 11 Turkey Vultures in the Monument, it is likely that such low numbers are more an indication of the behavior of the species (unless a Turkey Vulture is soaring within view, it is not likely to be detected) than its abundance. Other species such as Sharp-shinned Hawk, Golden Eagle, American Kestrel, Peregrine Falcon, and Prairie Falcon, which were all detected in very low numbers, were likely under-detected also.

While the surveys were conducted when the majority of piñon-juniper bird species was at the peak of singing, there are species in the Monument that begin their breeding cycles earlier in the

season and were likely brooding or fledging young during our surveys. Western Scrub-Jay, Pinyon Jay, Common Raven, Black-capped Chickadee, Mountain Chickadee, Juniper Titmouse, and Bushtit are all such species. Detections of these species may be low due to their secretiveness and lack of singing during the brooding and fledging processes. Also, if fledged birds are in the population during surveys, it is possible to count them as adult birds, thus skewing the surveys in favor of higher densities. This may have been the case for Bushtit, for which I calculated unusually high densities

As part of a related research project, I mapped the territories of two species, Gray and Plumbeous vireos (Giroir unpubl.), during the same time period as the point transects. During the mapping, I conducted systematic ground searches and used pre-recorded songs of both species to invoke territorial responses (Giroir unpubl.). I counted each singing male or pair of vireos as representing a breeding territory. I made a comparison of the two survey methods (territory mapping and point transects) in calculating Monument densities of the two species. As I only mapped territories of two species, these results should not be viewed as a test of the distance-sampling method. Since attempts to estimate densities of all common species in a community are likely to perform poorly for at least some species (Buckland et al. 1993), it is impossible to determine if the resultant differences in the densities provided by the two methods were due to problems with the study methods or problems related to the behavior of the species. A more in-depth study would be required to answer that question.

Point transect densities were higher than those of territory mapping (Table 2). The latter method has no way of accounting for detectability and, undoubtedly, I missed some birds during the mapping, thus accounting for part of the discrepancy. Also, difficult field conditions in the Monument may have introduced error into the point transect density estimates. The topography of the Monument made it impossible to run transects along truly random bearings. Many transects followed the contours of the canyons. However, since starting points for all transects were randomly selected, and no habitat other than cliff faces was purposefully avoided, error introduced by this difficulty should be minimal. The topography of the Monument, in some instances, also made distance estimates difficult. As in most bird surveys, the majority of birds were heard but not seen, and the acoustics in canyons (echos off of canyon walls and rocks) made origin of many sounds difficult to determine. Also, in many cases birds were detected several hundred feet above or below the observers, compounding the difficulties of locating sounds and estimating distances. One of the main assumptions of program DISTANCE is that distances to birds close to the points are measured accurately. Since most of the difficulties with distance estimates occurred with birds detected from great distances, it is expected that such difficulties would be inconsequential.

Territory mapping was substantially more labor intensive than point transects. I was able to map the territories of only two species during a three-week period, compared to the 25 species for which I was able to estimate densities with point transects during the same period. It should be stressed that no sampling method is without problems, and if the goal is to monitor change in density over time, then distance sampling provides the best method currently available for meeting this objective (Buckland et al. 1993, Fancey and Sauer 2000).

Table 2. Comparison of territory mapping and point transects at Colorado National Monument.

Species	Density / ha obtained by territory mapping	Density / ha obtained by point transects	% error
Gray Vireo	0.022	0.056	61
Plumbeous Vireo	0.006	0.030	80

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